

Formation of Superficial palmar arch and its clinical relevance - Cadaveric study

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Abstract

Background: Superficial palmar arterial arch is a dominant vascular structure of the palm. It is defined as the is an arterial arcade, formed by superficial branch of the ulnar artery and completed on lateral side by the superficial palmar branch of the radial artery or Arteria radialis indicis or Arteria princeps pollicis or arteria nervi mediana. Variations can occur in the vessels contributing to the formation of superficial palmar arch (SPA). **Aim:** The main objective of the study is to know the formation of superficial palmar arch and different types of formation with an emphasis on its clinical relevance. **Result:** In the present study was conducted on 30 specimens, we followed classification of Coleman and Anson. We found 75% complete arches and 25% incomplete arches. In complete variety type A and B were equally prevalent. The prevalence of incomplete arches was 25%, most common type of incomplete arch was, Type –B of group II. Some other variations were also found which are mentioned in the article. **Conclusion:** Knowledge of such variations is of immense help for microvascular surgeons, plastic surgeons and orthopaedicians to bring a better outcome in their surgical procedures. Also it will be helpful for cardiovascular surgeons to carryout radial artery harvesting procedures for the purpose of Coronary Artery Bypass Grafting.

Key words: Complete, Incomplete, Coronary Artery, median artery, superficial palmar arch, ulnar artery.

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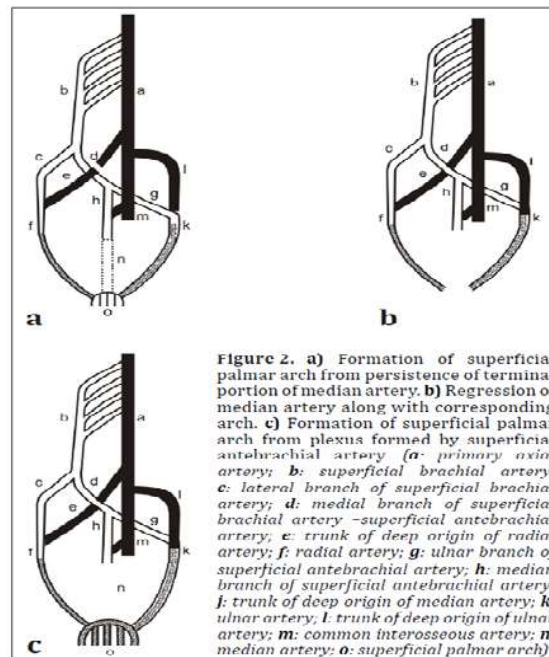
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INTRODUCTION

The arterial supply of the hand on the volar aspect consists of two systems, superficial and deep palmar arches. The superficial palmar arch (SPA) is arterial arcade that lies superficial to everything in the palmar compartment, i.e. in contact with deep surface of palmar aponeurosis. SPA is formed by the direct continuation of ulnar artery beyond the flexor retinaculum, it is often not a complete arch. If it

is complete, it becomes complete with the superficial palmar branch of radial artery. It is completed on radial side either by arteria princeps pollicis, arteria radialis indicis or arteria nervi mediana.¹ The arterial system develops from a multiple and a plexiform source, by sequential pattern of development, and functional dominance followed by regression of some path. Developmentally lateral branch of seventh intersegmental artery communicates with axis artery developing in situ in upper limb bud. This axis artery is represented by axillary, brachial, and interosseous arteries. The interosseous artery continues into hand plexus, and forms deep palmar arch. The ulnar, median, and radial arteries sprout from axial artery. Median arteries that sprout from axis artery usually accompany median nerve in hand and forms superficial capillary plexus Median artery regresses, loses its distal connection and superficial palmar plexus is fed by communication of the ulnar artery with the plexus to form the arch.²

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Variations in the superficial palmar arch have been studied by several authors. The palm is entirely supplied by both the SPA and deep palmar arch (DPA) with their anastomosis. Vessels of the palm bleed profusely but at the same heal rapidly as like the scalp owing to a good anastomosis. A detailed study of the functions of the hand is the basic requirement of all aspiring hand surgeons. The knowledge of variations of vascular patterns of hand gained more importance in microsurgical techniques, reconstructive hand surgeries, preoperative screening of radial artery harvesting for myocardial revascularization and also in arterial interventions that include radial artery cannulation and radial artery forearm flap.³

MATERIAL AND METHODS

Study is performed in the department of Anatomy at Raichur institute of medical sciences, RAICHUR, KARNATAKA. Both right and left palms of twenty formalin- preserved cadavers are dissected. The dissections of hands were performed as per the Cunningham's manual of practical anatomy.⁴ The course and branches of the radial and ulnar arteries in the hand were meticulously dissected, the formation of SPA was studied and the variations were observed.

Inclusion criteria: Intact palms of disarticulated upper limb specimens.

Exclusion criteria: we exclude those palms of hands with some pathologies, previous injury, fractures before death and also fractures after death due to poor handling during transport and storage and any kind of surgeries on hands, as all above conditions may alter the arch pattern and may mislead to our study.

RESULTS

In the present study we found 75% complete arches and 25% incomplete arches.

1. In complete arches, the classical SPA i.e. anastomosis between superficial branch of radial artery and superficial branch of ulnar artery, Type –A of Group I was observed in 35% of specimens
2. In another 35% SPA was completely formed by ulnar artery alone i.e. Type –B of Group I. UA is reaching 1st web space and dividing into two branches which are supplying radial side of index finger and thumb, representing Arteria radialis indicis (ARI) and Arteria princeps pollicis (APP) (fig-1)
3. Mediano-ulnar type of complete SPA (fig-2), Type –C of Group I was observed in 2 specimens (5%). In these specimens APP and ARI were arising from superficial palmar arch not from radial artery. Type D and E of Group I, are not observed in our studies.

In one complete arch formed by ulnar artery (ulnar type) alone is reaching 1st web space and dividing in two branches and trunk of radial artery in same space dividing into APP and ARI which are anastomosing with each other in this fashion



(fig-3). In one specimen with complete classical type of SPA there was a proximal communication between arteries constituting the arch. ARI and APP are arising from as shown in (figure-4). The prevalence of incomplete arches in our

study was 25%, seen in 10 specimens. Most common type of incomplete arch was, Type –B of group II, by Coleman and Anson i.e. SPA formed by ulnar artery but does not supply thumb and index fingers, was seen in 5 specimens (12.5%). Next most common type of incomplete arch was type-C of Group II, i.e. SPA formed only ulnar and median arteries but without anastomosis. In one of the incomplete Type –C SPA medial two and half digits are supplied by digital branches of ulnar artery and lateral two and half fingers supplied by digital branches from median artery, it was 50:50 in distribution. And the least prevalent incomplete type was Type-A of Group II, SPA formed by superficial branches of radial and ulnar arteries which was seen only in one specimen. Here APP and ARI were arising from superficial branch of radial artery. Like previous studies on SPA, in present study we also have observed majority of the complete superficial palmar arch and shown in table no-1

Table- no- 1 Results of present study(Classified as per Coleman and Anson Classification)

| Coleman and Anson classification | | Present study | |
|----------------------------------|--------|-----------------|-------|
| | | No. of specimen | % |
| Group – I | Type A | 14 | 35% |
| | Type B | 14 | 35% |
| | Type C | 2 | 5% |
| | Type D | None | - |
| | Type E | None | - |
| Group -II | Type A | 1 | 2.5% |
| | Type B | 5 | 12.5% |
| | Type C | 4 | 10% |
| | Type D | None | - |

Table -2: Different types of SPA by various authors along with present study

| AUTHORS | COMPLETE SPA | INCOMPLETE SPA |
|------------------------|--------------|----------------|
| Coleman and Anson | 78.5% | 21.5% |
| Ikeda <i>et al</i> | 96.4% | 3.6% |
| Loukas <i>et al</i> | 90% | 10% |
| Madhystha <i>et al</i> | 93.75% | |
| Suma MP | 95% | 5% |
| Venkateshwar Rao | 67% | 33% |
| Chandini Gupta | 77.3% | 22.6% |
| Singh <i>et al</i> | 92% | 8% |
| Arrchana | 72.5% | 27.5% |
| Present study | 75% | 25% |



Figure 1



Figure 2



Figure 3



Figure 4

Figure 1: complete-SPA (Type-B, Ulnar type); **Figure 2:** complete SPA, Type-C, Mediano-ulnar; **Figure-3:** showing Type-B with

anastomosis in 1st web space; || **Figure-3:** showing Type-B with

anastomosis in 1st web space ||

Figure-4: Complete classical SPA

Type-A, with proximal communication

DISCUSSION

The arterial supply of the hand on the volar aspect consists of two systems, superficial and deep palmar arches. The superficial palmar arch (SPA) is arterial arcade that lies superficial to everything in the palmar compartment. SPA is formed by the direct continuation of ulnar artery beyond the flexor retinaculum, it is often not a complete arch¹.

Superficial Palmar arch: Owing to a large number of variations in SPA, Poirier (1886) had found it extremely difficult to establish a type, while Adachi (1928) has described 3 types of superficial palmar arch.

- a) Ulnar type: in which contribution by radial artery is absent or minimal. It is seen in 59% dissections
- b) Radioulnar type: Seen in 32%
- c) Mediano ulnar type: seen in 9%

Huber (1930) groups the superficial palmar arch into 2 classes:

- I. Those in which additional branches from the forearm participate in the formation of the arch or replace the radial in its composition.
- II. Those in which there is no true arch, the arteries which should participate in its formation and in some cases the additional ones also, failing to anastomose and each giving rise independently to a certain number of digital branches in a somewhat fan like manner.⁵ Coleman and Anson (1961) elaborated more on superficial palmar arch and reclassified it as follows:

Group I:

Complete arch (Found in 78.5% cases). It can be further divided into five types:-

Type A: The classical radio ulnar arch is formed by superficial palmar branch of radial artery and the larger ulnar artery. It was found in 34.5% dissections.

Type B: This arch is formed entirely by ulnar artery. It was found in 37% cases.

Type C: Mediano ulnar arch is composed of ulnar artery and an enlarged median artery. It was found in 3.8% specimens

Type D: Radio-mediano-ulnar arch in which 3 vessels enter into the formation of arch. It was found in only 1.2% dissections.

Type E: It consists of a well formed arch initiated by ulnar artery and completed by a large sized vessel derived from deep arch. The latter vessel comes to superficial level at the base of the thenar eminence of join the ulnar artery. It was found in 2% cases.

Group II:

Incomplete arch: When the contributing arteries to the superficial arch do not anastomose or when the ulnar artery fails to reach the thumb and index finger, the arch is incomplete, such type of arch was found in 21.5% cases. It can be further divided into 4 types.

Type A: Both superficial palmar branch of radial artery and ulnar artery take part in supplying palm and fingers but in doing so, fail to anastomose. It was found in 3.2% cases.

Type B: Only the ulnar artery forms superficial palmar arch. The arch is incomplete in the sense that the ulnar artery does not take part in the supply of thumb and index finger. It was found in 13.4% dissections.

Type C: Superficial vessels receive contributions from both median and ulnar arteries but without anastomosis. It was found in 3.8% specimens.

Type D: Radial, median and ulnar artery all give origin to superficial vessels but do not anastomose. It was found in 1.1% cases.⁶

The SPA is classified into two categories: complete or incomplete. An arch is considered to be complete if an anastomosis is found between the arteries constituting it. An incomplete arch has an absence of a communication or anastomosis between the arteries constituting the arch. This classification is currently in use and provides the simplest understanding of the anatomic distribution of the arches.⁷


Coleman *et al* observed the complete form in 78.5% and incomplete form in 21.5% of 650 hands.⁸ Ikeda *et al* demonstrated 96.4% complete and 3.6% incomplete forms.

⁹ The complete SPA was observed in 90% and incomplete SPA was observed in 10 % of cases by Loukas *et al*¹⁰. Complete formation in 78% and incomplete formation 16% in specimens by Patnaik *et al*⁵, complete arch in 84% and incomplete arch in 16% by Al-turk *et al*.¹¹ Complete arch in 72.5% and incomplete arch in 27.5% by Archana *et al* 2018¹² and Chandini Gupta observed 77.3% complete % 22.6% incomplete types.¹³ Our study shows complete arch in 75% and incomplete arch in 25% of specimens, the values which close to study done by Coleman and Anson, Chandini Gupta and Archana *et al*. (table-2)

In our study the formation of complete SPA by the linkage or anastomosis between superficial branch of ulnar and radial arteries i.e. the classical type of SPA was found in 35 % of the specimens.

Coleman and Anson, Loukas *et al*, Madhystha *et al*, Suma MP *et al* and Archana *et al* observed the classical type of SPA in 34.5%, 40%, 93%, 95% and 35% respectively, the values are very close to Coleman and it is equal to the values observed by author Archana *et al*. Among the complete SPA formed only by ulnar artery i.e. type B found in 35% of specimens by Loukas, Coleman and Anson found in 37% of specimens, Archana *et al* in 27.5%, apart from this many authors have reported case reports of SPA formation by ulnar artery alone like Geethadevi¹⁴, Sharmishta Biswas¹⁵, and VR vallola¹⁶ respectively. During our study we observed SPA formed by ulnar artery i.e. type- B SPA, in 35 % of specimens, our values are equal to the values of Loukas *et al* and very close to

Coleman and Anson. In one complete arch formed by ulnar artery (Ulnar type) is reaching 1st web space and dividing in two branches and trunk of radial artery in same space dividing into APP and ARI which are anastomosing with

each other in this fashion  (Shown in figure-3), such variation is not reported by any authors so far. The median artery (MA) is the axis artery of the superior extremity during early embryonic life. It maintains the superficial palmar arch while the radial and ulnar arteries are developing. The persistence of the median artery in the human adult has been considered as the retention of a primitive arterial pattern. The incidence of median artery is between 1.5%-27.1%. The origin of the median artery has been previously described as arising from the ulnar, interosseous, radial, brachial arteries. Association of a persistent median artery with the median nerve should be considered in the evaluation of all patients with carpal tunnel syndrome. kavitha¹⁷.

A persistent median artery may take part in SPA in different patterns. Coleman and Anson in their study reported the contribution of median artery to SPA in 9.9%, among which 3.8% of specimens were complete mediano ulnar type, 1.2% complete radio mediano ulnar type, 3.8% incomplete mediano ulnar and 1.1% incomplete radio mediano ulnar type. Mamatha Tonse *et al* observed mediano ulnar type of complete arch in 12%¹⁸. Takkallapalli Anitha *et al* in their study, found median artery contribution to SPA in 6% of specimens, of which 4% showed complete mediano ulnar type and 2% showed incomplete mediano ulnar type.¹⁹ In study by Archana, persistent median artery taking part in SPA was found in 15% specimens, of which 7.5% specimens is of complete mediano ulnar, 2.5% is of complete radio mediano ulnar type and 5% specimens is of incomplete mediano ulnar type. In the present study persistent median artery was seen in 15% of specimens, in which complete mediano-ulnar type was present in 5% and incomplete mediano-ulnar type was observed in 10% of the specimens. Our values are similar to study done by Archana but types of SPA formed by persistent arteries were different.

CONCLUSION

The present study has revealed details about some of the variations of superficial palmar arch in humans cadavers which will be supplementing to our already existing knowledge of variations. Variations in the vascular pattern of the hand have been the subject of many studies; these variations may serve as substantial interest to orthopedic surgeons, plastic surgeons, radiologists, and anatomists. These variations are in mode of origin or branching pattern, unexpected relationship with surrounding structures and occupation of unusual tissue planes. In

addition, the identification of any variation in the arterial pattern of the hand using Doppler ultrasonography, photo plethysmography and oximetric techniques acquires great importance in various surgical interventions in the hand. Our study gives the necessary information to understand the vascular architecture and its common and rare variations in the hand.

REFERENCES

1. Chummy S. Sinnatamby. Last's Anatomy - Regional and applied. Churchill Livingstone Elsevier. 12th ed. pp.83
2. Chavan Kalidas Sushma and Wabale Rajendra Namdeo. Subcutaneous superficial palmar arch - an unusual variant. Int J Anat Var. 2014;
3. Suma M.P. Vijay Kumar S, Priya Ranganath. An Anatomical study of superficial palmar arch. Int J Anat Res 2014, Vol 2(4):735-39.
4. Romanes G.J. Cunningham's Manual of Practical Anatomy In: The Upper limb- The forearm and Hand. Vol. I, 15th Edn. Oxford University Press, Oxford : pp - 74-104 (1999)
5. Patnaik, VVG, Kalsey G, Singla RK. Palmar arterial arches a morphological study. J Anat Soc India. 2002;51(2):187-93
6. P. Venkateswara Rao, A. Hemalatha Devi. A Study on Superficial Palmar Arch and its Variations. Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 12, March 23, 2015; Page: 1766-1775.
7. Madhyastha S, Murlimanju BV, Jiji PJ, Saralaya VV, Rai A. Vadgaonkar R. Morphological variants of the human superficial palmar arch and their clinical implications. J. Morphol. Sci. 2011;28(4):261-264
8. Coleman, S. and Anson, J. (1961): Arterial pattern in hand based upon a study of 650 specimens. Surgery Gynaecology Obstetrics. 96: 43-54.
9. Ikeda, A., Ugawa, A., Kazihara, Y., Hamada, N. Arterial patterns in the hand based on a three dimensional analysis of 220 cadaver hands. J. Hand Surg 1988; 13A:501-09.
10. Loukas M, Holdman D, Holdman S. Anatomical variations of the superficial and deep palmar arches. Folia Morphologica (Warsz). 2005;64(2):78-83.
11. Al-Turk M, Metcalf WK. A study of superficial palmar arch using the Doppler ultrasonic flow meter. J Anat. 1984;138(1):27-3.
12. Archana. S, Arumugam. K, Sreevidya. J, Sudha Seshayyan. Anatomical study of superficial palmar arch and its variations with clinical significance. Int J Anat Res 2018;6(2.1):5127-5133
13. Chandni Gupta, Sneha Guruprasad Kalthur, Narga Nair, Shakuntala R Pai. A Morphological study of variations in superficial palmar arches of the hand. CHRISMED Journal of Health and Research 2015;2(2):140-144.
14. Karey GDV, Rayudu RM, Toleti S. A variation of superficial palmar arch formed alone by ulnar artery: a case report. Int J Res Med Sci 2015;3:777-9
15. Sharmistha Biswas, Paromita Mukhopadhyay, Sushmita Sen, Sarmistha Chakraborty, Biswa priya sinha, Hasi Dasgupta. Superficial Palmar arch; some

- interesting variations. Indian Journal of Basic and Applied Medical Research; Dec 2014; 4(1):154-159.
16. Rao S, Vollala VR, Pamidi N, Nagabhooshana S, Potu BK. Variant formation and distribution of the superficial palmar arch. Indian J PlastSurg 2010; 43:116-7.
 17. Kavitha K., Sushma, Prima D'Souza and Vishal Kumar. Absence of superficial palmar arch with persistent median artery - a case report. NUJHS Vol. 4, No.3, September 2014.
 18. Mamatha Tonse, Rajalakshmi Rai, Vasudha Saralay, Rajanigandha Vadgonkar, Ashwin R.Rai, Roshni Sadashiv. Formation of Superficial palmar arch; A cadaveric study with its clinical significances. IOSR Journal of Dental and Medical Sciences 2014; 13(3ii):100-103.
 19. Takkallapalli Anitha, Sanjay Kalbande, Dattatray Dombe, Krishnamurthy Asha, Neelee Jayashree. Variations in the formation of superficial palmar arch and its clinical significance in hand surgeries. Int. J Biol Med Res. 2011; 2(2); 543-546.
 20. S.Singh, L.Lazarus, B.Z.De Gama, K.S.Satyapal. An anatomical investigation of the superficial and deep palmar arches. Folia Morphol.2017; 76(2):219-225.

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